## EXERCISE 1.2

Lims

Evaluate the indicated limits (Problems 1-30):

1. 
$$\lim_{x \to 2} \frac{x-2}{\sqrt{2+x}}$$

ems 1-30):

2. 
$$\lim_{x \to 1} \frac{x^3-1}{x-1}$$

3. 
$$\lim_{x \to 1} \left( \frac{1}{1-x} - \frac{3}{1-x^3} \right)$$

4. If 
$$P_n(x) = a_0 x^n + a_1 x^{n-1} + ... + a_{n-1} x + a_n$$
, prove that
$$\lim_{x \to a} P_n(x) = P_n(a)$$

7. 
$$\lim_{x \to 0} \frac{1 - \cos x}{x^2}$$

9. 
$$\lim_{x \to x} \frac{\tan (\sin x)}{\sin x}$$

$$\lim_{x \to 0} \sin \left(\frac{1}{x}\right)$$

13. 
$$\lim_{x \to \infty} \frac{4x^3 - 2x^2 + 1}{3x^3 - 5}$$

15. 
$$\lim_{x \to \infty} \left(1 - \frac{1}{x}\right)^x$$

$$\sqrt{17}. \lim_{x \to \infty} \frac{a^x - 1}{x}, (a > 1)$$

6. 
$$\lim_{x \to 0} \frac{\sin ax}{\sin bx}$$

8. 
$$\lim_{y \to x} \frac{y^{2/3} - x^{2/3}}{y - x}$$

10. 
$$\lim_{x \to 0} x \sin\left(\frac{1}{x}\right)$$

12. 
$$\lim_{x \to \infty} \frac{\sqrt{x^2 + 1}}{x + 1}$$

14. 
$$\lim_{x \to \infty} \left(1 + \frac{2}{x}\right)^x$$

16. 
$$\lim_{x \to \infty} \left( \frac{x}{1+x} \right)^x$$

18. 
$$\lim_{x \to \infty} \frac{x^4 - 2x^2 + 6}{x^2 + 7}$$

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19. 
$$\lim_{x \to \pm \infty} \left[ \frac{x^2}{x+1} - \frac{x^2}{x+3} \right]$$
20.  $\lim_{x \to \infty} (x - \sqrt{x^2 - a^2})$ 
21.  $\lim_{x \to \infty} \frac{x^2 + 1}{x^{3/2}}$ 
22.  $\lim_{x \to \pm \infty} \frac{5x^3 + 3x^2 - 1}{x - 4x^4}$ 
23.  $\lim_{x \to \pm \infty} \left[ \frac{x^2}{x+3} - \frac{x^2}{x+5} \right]$ 
24.  $\lim_{x \to \pm \infty} \left[ \frac{x^2}{x+3} - \frac{x^2}{x+5} \right]$ 
25.  $\lim_{x \to \pm 0} \left[ \frac{x^2}{x+3} - \frac{x^2}{x+5} \right]$ 
26.  $\lim_{x \to \pm \infty} \left[ (4x^3 - 3x^2 + x - 1) \right]$ 
27.  $\lim_{x \to \pm 0} \frac{\sqrt{1-x^2}}{1-x}$ 
28.  $\lim_{x \to \pm 0} \frac{x-1}{\sqrt{x^2-1}}$ 
29.  $\lim_{x \to \pm 0} \frac{\sqrt{4-x^2}}{\sqrt{6-5x+x^2}}$ 
30.  $\lim_{x \to \pm 0} \frac{x-1}{\sqrt{x^2-1}}$ 
31. Let  $f(x) = \begin{cases} x^2 + 3 & \text{if } x \le 1 \\ x+1 & \text{if } x > 1 \end{cases}$ 
Find  $f(1+0)$  and  $f(1-0)$ .

29.  $\lim_{x \to \pm 0} \frac{x}{\sqrt{x^2-1}}$ 
31. Let  $f(x) = \begin{cases} 3 & \text{if } x \le 2 \\ -\frac{1}{2}x^2 & \text{if } -2 < x < 2 \\ 3 & \text{if } x \ge 2 \end{cases}$ 
Find  $\lim_{x \to 0} f(2+0)$ ,  $\lim_{x \to 0} f(2+0)$ 
32. Let  $\lim_{x \to 0} f(x) = \begin{cases} x^2 - 1 & \text{if } x \le 2 \\ \sqrt{x+7} & \text{if } x > 2 \end{cases}$ 
Find  $\lim_{x \to 0} f(x)$ .

33. Let  $\lim_{x \to 0} f(x) = \begin{cases} x^2 - 1 & \text{if } x \le 0 \\ 1-x & \text{if } x > 0 \end{cases}$ 
Find  $\lim_{x \to 0} f(x)$ .

35. Let  $\lim_{x \to 0} f(x) = \begin{cases} x^2 & \text{if } x \le 1 \\ x^3 & \text{if } x > 1 \end{cases}$ 
Show that  $\lim_{x \to 0} f(x) = \begin{cases} x+2 & \text{if } x \le 1 \\ x^3 & \text{if } x > 1 \end{cases}$ 
Find  $x \to 0$ 
Fin

37. Evaluate 
$$\lim_{x \longrightarrow 3+0} \frac{3-x}{|x-3|}$$

38. Evaluate 
$$\lim_{x \longrightarrow 0-0} \frac{x}{|x-||x|}$$

39. Find 
$$\lim_{h \to 0-0} \frac{|-1+h|-1}{h}$$

40. Evaluate,  $[\cdots]$  being the bracket function:

(i) 
$$\lim_{x \longrightarrow 1} \left[2x\right](x-1)$$
 (ii)  $\lim_{x \longrightarrow 0} \left[x\right]\left[x+1\right]$ 

(iii) 
$$\lim_{x \to 0} x \left[ \frac{1}{x} \right]$$
 (iv)  $\lim_{x \to 0} x^3 \left[ \frac{1}{x} \right]$ .

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 $\frac{3}{3} \left( \frac{4x^3 - 2x^2 + 1}{3x^3 - 5} \right)$  $= \frac{1}{2} = \frac{1}{2} = \frac{1}{2} = \frac{1}{2} = \frac{1}{2}$  $\frac{1}{x^3}\left(3-\frac{5}{x_3}\right)$ 24 - 2 +1 X-94 3 - 5

All Aut x = y x -> 0, y -> 0

= 4-0+0 = 3 Az

(4 24 (1+2)X x = 20 [(1+ =) =]  $= e^{2} \quad : (1+2)^{2} = e^{2}$ 

(15 x + 0 (1-2) x -x)

(1) Can be Whiter as

対の(ナ(支)) = (文) (1+(女))

= e=1/e

(B)  $x \to \infty$   $\left[\frac{x}{1+x}\right]^{2}$  $x \to \omega \left(\frac{1+x}{x}\right)^{-x}$ (1+2)x) = e = //e

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(7)  $x \to \infty$  (2-1)Let y= a-1 When x - 00 , 4 - 00  $a^2 = y + 1$ 

Taking In 950th Sides/ wego 2 ha = h(3+1)

 $x = \frac{\ln(1+7)}{\ln a}.$   $2 \to \infty \frac{q^2 - 1}{x} = \frac{\sqrt{3}}{\sqrt{3}} \frac{y}{\ln(4+7)}$ 

= 1 f h (4+8)

:  $y \to \infty (1+y)^y = (\infty)^0 = 1 (assume)$ 

 $= \frac{\ln a}{0} = \frac{\ln a}{0} = \infty$ 

2nd Solution &

 $= ha \frac{y}{h(1+0)}$ 

 $= ha \cdot \frac{\infty}{\infty}$ 

ha 3-30 (1+0) = hax 0 = 0

 $\frac{\partial R \text{ 3rd way}}{\partial x^{2} + \partial x^{2}} = \frac{\lambda \ln a - o}{1} = \frac{\lambda \ln a - o}{1}$ 

 $= \frac{1}{2} \frac{$ Pat 04=1+h 1+xh+x(x-1) h+...-+ =x[h+x-1 +2......] 2500 (1th) x-1 = x >0

$$\begin{array}{c}
18) 24 \\
\chi \rightarrow \infty \quad \frac{\chi' - 2\chi' + 6}{\chi^2 + 7}$$

$$\begin{array}{c}
1 \\
\chi \rightarrow \infty \quad 1 - 2 \\
\chi \rightarrow \infty \quad 3 \\
\chi \rightarrow$$

$$\begin{array}{c}
(9) \begin{array}{c}
\chi^{2} \\
\chi \rightarrow \pm \infty \end{array} \left[ \begin{array}{c}
\chi^{2} \\
\chi + 1
\end{array} - \begin{array}{c}
\chi^{2} \\
\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi + 3\chi^{2} - \chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi + 3\chi^{2} - \chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$= \chi \rightarrow \pm \infty \left[ \begin{array}{c}
\chi^{2} \\
\chi^{2} + 4\chi + 3
\end{array} \right]$$

$$=\frac{2}{1+0+0}=2+\frac{1}{1+0}$$

$$\frac{2n^{M-1}}{\chi^{2} - 2n} \left[ \chi - \sqrt{\chi^{2} - \alpha_{1}} \right]$$

$$= \frac{\lambda}{\chi + 2n} \left[ \chi - \chi \left( 1 - \frac{\alpha^{2}}{21} \right)^{\frac{1}{2}} \right]$$

$$= \frac{\lambda}{\chi + 2n} \left[ \chi - \chi \left( 1 + \frac{1}{2} \left( -\frac{\alpha^{1}}{21} \right) + \frac{1}{2} \left( \frac{1}{2} - 1 \right) \left( -\frac{\alpha^{2}}{21} \right)^{\frac{1}{2} + \dots } \right]$$

$$= \frac{14}{x \to \infty} \left[ x - x - \frac{q^2}{2x} - \frac{1}{8} \cdot \frac{a^4}{23} + \dots \right]$$

$$M-2 \left[ \chi - J \chi^{2} - a_{2} \right] \times \left[ \chi + J \chi^{2} - a_{1} \right]$$

$$= \chi^{2} - \chi^{2} + a^{2}$$

$$= \chi + J \chi^{2} - a_{1}$$

$$\chi + J \chi^{2} - a_{1}$$

$$\chi + \sigma$$

$$\frac{21}{x \rightarrow \infty} \frac{x^2 + 1}{x^{3/2}}$$

$$\frac{1}{5} \frac{5y}{x^2} \frac{x^2 + 1}{x^{2/2}}$$

$$\frac{1}{5} \frac{5y}{x^2} \frac{x^2 + 1}{x^2}$$

$$\frac{1}{2} \frac{1}{2} \frac{1}{2} \frac{1}{2}$$

$$\frac{1}{2} \frac{1}{2} \frac$$

$$2 \frac{1}{2} \left[ 1 + \frac{1}{2} \right]$$

$$= \infty \left( 1 + 0 \right) = \infty A_{12}$$

$$OR Put x = \frac{1}{2} \left( \frac{1}{2} + \frac{1}{2} \right)$$

$$\frac{\partial x}{\partial x} = \frac{\int x^3 + 2x^2 - 1}{x - 4x^4}$$

$$\frac{\partial x}{\partial x} = \frac{\int x}{x} + \frac{2}{x^2} - \frac{1}{x^4}$$

$$\frac{\int x}{x} + \frac{2}{x^2} - \frac{1}{x^4}$$

$$= \frac{\partial x}{\partial x} = \frac{\partial x}{\partial x} = \frac{\partial x}{\partial x} = 0$$

$$= \frac{\partial x}{\partial x} = \frac{\partial x}{\partial x} = 0$$

2nd way

Note Since the limit

of quotient of Polynomial

as  $x \to \pm \infty$  is the Same

as The limit of the

quotient of the lighest

Power terms.  $x \to \pm \infty$  5 = 5 5 = 5

$$= \frac{1}{x + 1} = \frac{5}{4x} = \frac{5}{x} = 0$$

$$= \frac{1}{x + 1} = \frac{5}{x + 1} = \frac{5}{x} = 0$$

$$= \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{5}{x + 1} = 0$$

$$= \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{5}{x + 1} = 0$$

$$= \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = 0$$

$$= \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = 0$$

$$= \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = \frac{1}{x + 1} = 0$$

Best Takl higher Power Term

Note 
$$\frac{1}{4}$$
 $x \to \pm \infty$   $(4x^3 - 3x^2 - 1)$ 
 $= \frac{1}{4} + 2 \times 4x^3$ 
 $= \pm \infty$ 
 $=$ 

 $26 \cancel{x} + \cancel{2} \cancel{x} + 2x - 8$   $\cancel{x} \rightarrow -2 \frac{\cancel{x}^2 + 2x - 8}{\cancel{x}^2 - 4}$  $= x \rightarrow -2 \qquad x^2 + 4x - 2x - 8$ (x-2) (x+2) 2+ - (x+4)(x-2) (x-2) (x+2) X-7-2 2+4 X-7-2 7+2  $= h \xrightarrow{>0} -2 - h + 4 \qquad \chi = -2 - h$   $-\chi - h + 2 \qquad h \xrightarrow{>0} \chi \rightarrow -2$  $=\frac{2-h}{h\rightarrow 0}=\frac{2}{h\rightarrow 0}+1=-\infty$  $\frac{\dot{y}}{h} = \frac{h-2}{h} = \infty \text{ Am (Greet)}$ 29 - VI+X 11-X Put x=1-h LH. Lind h->0 1/1+1-h = V2-h

1/7-1/+h h->0 /h  $= \frac{\sqrt{2-0}}{\sqrt{2}} = \infty A_{\frac{1}{2}}$ and Alt Put x = 1-h  $\frac{h \to 0}{1 - (1-h)^2}$ ようの(シートン)=ようの(シート) = WAW

$$(28) \begin{array}{c} 24 \\ x \rightarrow 1 \end{array} \begin{array}{c} x - 1 \\ \sqrt{x^2 - 1} \end{array}$$

$$= \frac{24}{x-1} + \frac{x-1}{\sqrt{(x-1)(x+1)}}$$

$$= \frac{21}{x+1} + \frac{\sqrt{x-1}}{\sqrt{x+1}}$$

$$=\frac{\sqrt{h}}{\sqrt{2+h}}=\frac{o}{\sqrt{2+o}}=o \int_{\frac{\pi}{2+o}}^{m}$$

$$29$$
  $24 - 54 - 54 - 72 = 76 - 5x + x2$ 

$$\frac{1}{\chi - 32} \frac{\int (2-x)(2+x)}{\int (2-x)(3-x)}$$

$$= x^{2} - 3x - 2x + 6$$
$$= x(x - 3) - 2(x - 3)$$

$$= (x-3)(x-2)$$

$$= \frac{14}{x \rightarrow 2} = \frac{\sqrt{2+x}}{\sqrt{3-x}}$$

Put 
$$x = 2 - h$$

$$\frac{1}{\sqrt{6-5(2-h)+(2-h)^2}}$$

$$= 1 + \frac{L}{\infty} \qquad l \in (-1, 1)$$

$$= 1 + 0 = 1$$

$$\begin{cases}
31 \\
f(x) = \begin{cases}
\chi^2 + 3 & \text{if } \chi \leq 1 \\
\chi + 1 & \text{if } \chi > 1
\end{cases}$$

$$f(1+0) = \frac{1}{\varkappa \rightarrow 1+0} f(\varkappa) = \frac{1}{\varkappa \rightarrow 1} (\varkappa + 1)$$

$$f(1-0) = x \rightarrow 1-0^{f(x)} = x \rightarrow 1/(x^2+3)$$

$$x \to 2$$
  $f(x) = x \to 2 (4x^2) = -\frac{1}{2}(2) = -2$ 

$$2f$$

$$x \rightarrow -2 f(\alpha) = x \rightarrow -2 3 = 3$$

$$\chi \rightarrow -2 f(x) = \chi \rightarrow -2 \left(-\frac{1}{2}\chi^{2}\right)$$

$$=-\frac{1}{2}(-2)^{\frac{1}{2}}=-2$$

 $\frac{33}{f_{(x)}} = \begin{cases} x^{2} - 1 & \text{if } x \leq 2 \\ \sqrt{x+7} & \text{if } x \neq 2 \end{cases}$ find fox) as x -> 2  $\chi \rightarrow 2^{+} f(x) = \chi \rightarrow 2 \sqrt{x+7}$ = 12+7  $= \sqrt{9} = 3$   $(x^2 - 1) = x - 2 (x^2 - 1)$  $\begin{array}{c} 12 \\ \times \rightarrow 2 \\ \end{array} \begin{array}{c} f(x) = 12 \\ \times \rightarrow 2 \\ \end{array} \begin{array}{c} f(x) = 3 \\ \end{array}$ Then L+  $\chi \rightarrow \chi f(x) = 3$  limit Exist  $f(\alpha) = \begin{cases} (0) \times \dot{\gamma} & \gamma \leq 0 \\ 1 - \chi & \dot{\gamma} & \gamma > 0 \end{cases}$ find x -> Pox)  $x \rightarrow 0^{\dagger} f(x) = x \rightarrow 0 (1-x)$ 2->0 f(x) = x ->0 Gsx = (05(0) x -> 0 for = x -> 0 for = 1 x->0 fox) = 1 Limit of fr. Exists.

 $f(x) = \begin{cases} x^2 & \forall x \leq 1 \\ x^3 & \forall x \leq 7 \end{cases}$ Shoother  $(x \to 1)^{+} f(x) = 1$   $(x \to 1)^{+} f(x) = (x \to 1)^{3} = (1)^{3}$ x+1 f(x) = x+1 x2 = (1)=1 LHL = RH.L =1 24, for =1  $\frac{3}{2} x = \begin{cases}
x + 2 & \forall x \leq -1 \\
0 \times 2 & \forall x > -1
\end{cases}$ find'a, Sotter 2 -1 for Exists Because given that  $x \to -1$  for expi  $x \rightarrow -1^{+} f(x) = x \rightarrow -1^{-} f(x)$  $\chi \rightarrow -1 (9 \chi^2) = \chi \rightarrow -1 (\chi_{+2})$  $a(-1)^{\perp} = (-1+2)$ a = 1 = 1 4

38) E Valuate  $x \rightarrow 0$   $\frac{x}{x-|x|}$ for LH. Limit 2<0 |2 =-2  $\frac{2+-}{x-0}\frac{x}{x-(-x)}$ x-70 2x 八分。(主)一支加 (39) h→0 |-1+h|-1 h. Mod. ·= |-(1-k)|=(1-k) h ->0 (1-h)-1 =-1  $M_2$ 2 - 1-1+h -1 |-1+h| = -(-1+h)= 1-h  $= h \xrightarrow{\rightarrow} = \frac{1-h-1}{4}$ is h-70+ 1-1+h1-1 1-1+11=+(-1+2) Lim + -1+h-1 h-70+ -2+h  $=\frac{-2+0}{2}=-\infty$ 

(40) Evaluate [...] being the bracket &n. (1, 24) [2x] (x-1)1 7 7 0 = 0 = X Z 1  $x \rightarrow Lo[2x] = \emptyset$ : [2(+0)] as value of x is slightly = [+(3] = 01/ Less than 1 is and [2x] is Greatest integer = x = 1-0 [2x] (x-1) Less than 1 is 1 = 10 (1-1) = 0 V x -> 1+0 [2x] (x-1) ·: 2->1+0 [2x] = (2)(1-1) x is Slightly greater Than 1 = 0 x->1+0[2x]=2 LHL = en.L : [2(1-1)]  $\int_{\alpha}^{\infty} \int_{\alpha}^{\infty} f(\alpha) = 0$ [2.2] = 2 ij lin 2-1 [x][x+1] 24  $2 \rightarrow 1 \quad \{x\} = 0$ 27 [x] [x+1] スラー [4+1]=1  $\beta$ . (1)(2) = 2 X71 f(x) does not Exit Correction x → 0 [x] [x+1] (x)=(-·5) 270 = 0-1  $x \xrightarrow{4} - (x)(x+1)$ ∠ (x+1) = [-·S+1] ∠ (x+1) = [·S] (-4)(0) = 0x = 0 [x] [x+1) (0)(1)=0 $\begin{cases} x \\ x \\ \Rightarrow x \end{cases} = [x] = 0$ LH.L = R.H.L  $\begin{array}{ccc} X \rightarrow Q &= & [1:2] \\ Y' &= & [X+1] = & [\cdot 2+1] \end{array}$ x -> [x][x+1] = 0 Am

 $(11), \chi_{+} \times \left(\frac{1}{\chi}\right)$   $(21), \chi_{+} \times \left(\frac{1}{\chi}\right)$   $(21), \chi_{+} \times \left(\frac{1}{\chi}\right)$   $= 0 \left(\frac{1}{-1}\right) = 0$   $\chi_{-90} = \chi_{-90+0} \times \left(\frac{1}{\chi}\right) = 0 \left(\frac{1}{7}\right) = 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$   $\chi_{-90} \times \left(\frac{1}{\chi}\right) = 0 \text{ for } 0$ 

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